POLLUTION DETECTION IN LAKE CHAMPLAIN USING ERTS-1 IMAGERY

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This report constitutes a significant result under NASA categories 7.C, Lake Pollution Surveys and 8.E., Image Enhancement Techniques.

11 p.

Background

The limnological program of the University of Vermont has included a special study of the narrow southern end of Lake Champlain between Fivemile Point and Lapham Point. This part of the lake receives waste water discharge from a new paper mill located on the New York side of the lake just north of historic Fort Ticonderoga.

Water samples have been collected from the study area before and after the plant began operation in early 1971. The waste water discharge enters the lake through a submerged diffuser which extends to the middle of the main channel. A sampling grid was established in this area and samples were collected in this area and samples were collected and analyzed for a number of constituents and properties. Isopleth maps derived from the water sampling program conducted after the paper mill began discharging waste water indicate the presence of a plume on the basis of chemical evidence above. As indicated in Figures 1 to 3, dissolved oxygen, conductivity, and sodium appear to show the pluming effect best. Surface observations in the study area have recorded reddish-brown discoloration of the water. The plume is fairly large and either moves to the east or to mid-lake where it is transported northward giving the plume a geniculate

configuration, or it may simply form a vector path pointing northeast toward Lapham Point on the Vermont shore.

Application of ERTS-1 Imagery to Water Pollution Monitoring

An examination of 10 October, ERTS-1 coverage of Lake Champlain in MSS bands four and five (.5 - .6 and .6 - .7 micrometers) was conducted using the 9.5 inch positive transparencies and the variable magnification provided by Baush and Lomb 240 Stereozoom optics. ERTS-1 image number 15115 shows the study area described above clearly and under 4X magnification the plume that had been documented by chemical evidence in previous studies was discovered visually on the image. The plume is best seen on MSS band 4 imagery, but may also be recognized on MSS band 5, where it appears as a darker tone in the context of the generally lighter toned, turbid lake water characteristic of this portion of the lake. The MSS band 4 rendition may be seen in Figure 4 as reproduced by Polaroid MP-3 copy camera equipment. An enhanced false-color rendition reveals the plume even more clearly. The enhanced version was produced using enlarged positive transparencies of MSS bands 4, 5, and 6 as viewed through Spectral Data Corporation's multispectral viewer. Photographic reproduction was accomplished with the Polaroid MP-3 copy camera.

The discovery of this pollution plume on ERTS imagery provides a considerable benefit in that its extent and magnitude can now be observed remotely. The specific limnological variables associated with the plume will require additional sampling in this area and will be reported in subsequent a report.

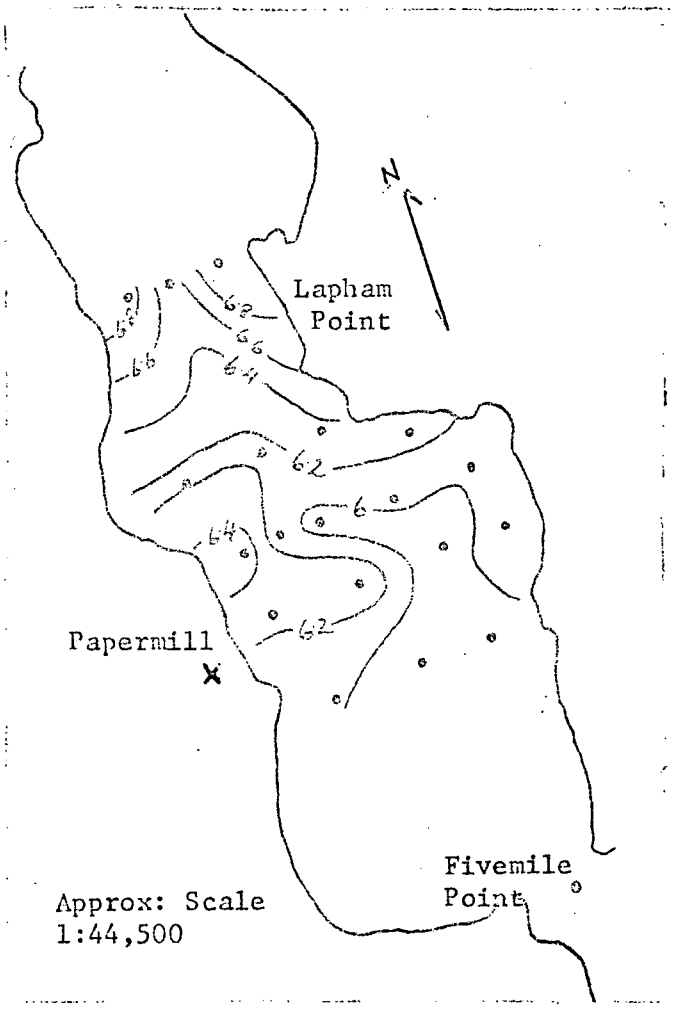

Figure 1. Distribution of sodium concentration in the discharge area (mg /l.). Points represent the sampling grid.

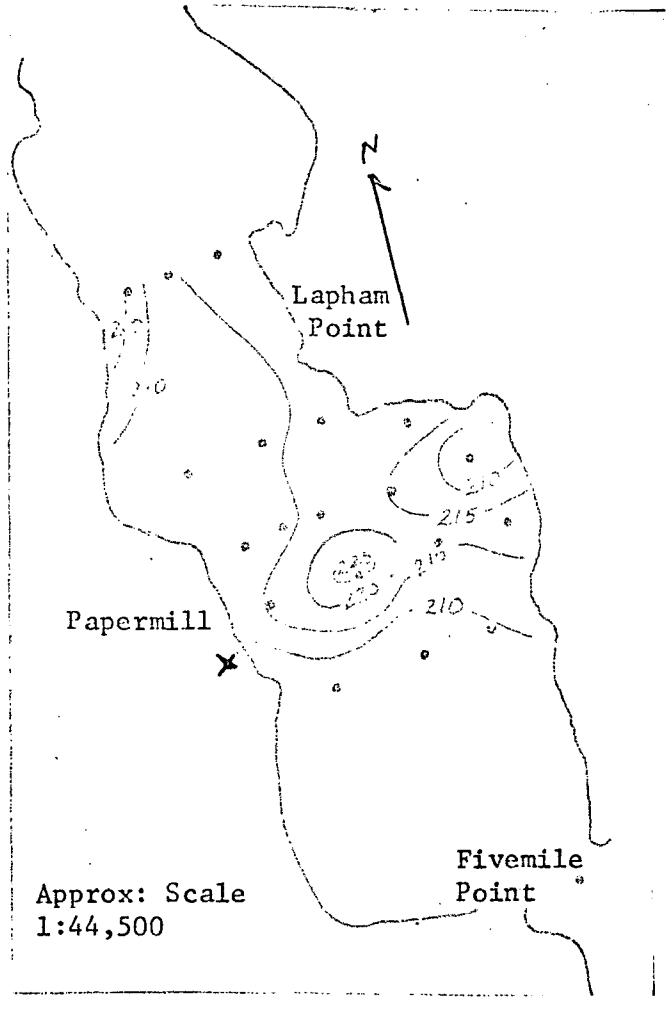

Figure 2. Distribution of conductivity (micromohs) in the discharge area.

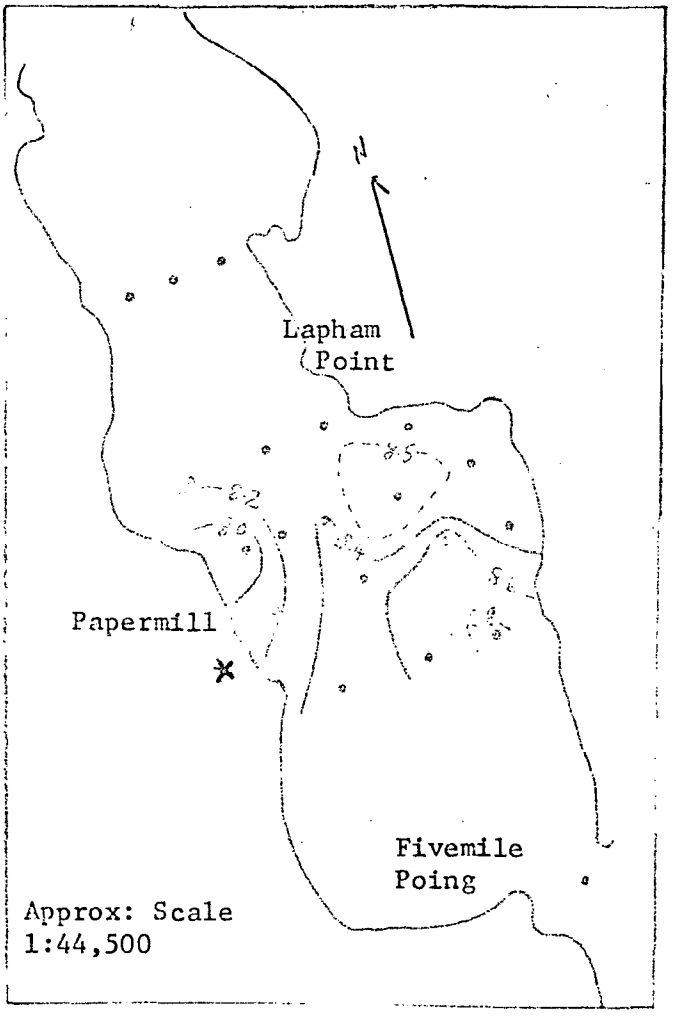

Figure 3. Distribution of dissolved oxygen in the discharge area. (mg /l.) Low values are associated with the discharge plume.

Figure 4. Polaroid (Type 52 film) rendition of the waste discharge area from Band 4, ERTS-1 image 15115. The discharge plume is the dark toned area near the center of the photo just below the red dot. Scale is approximately 1:125,000.

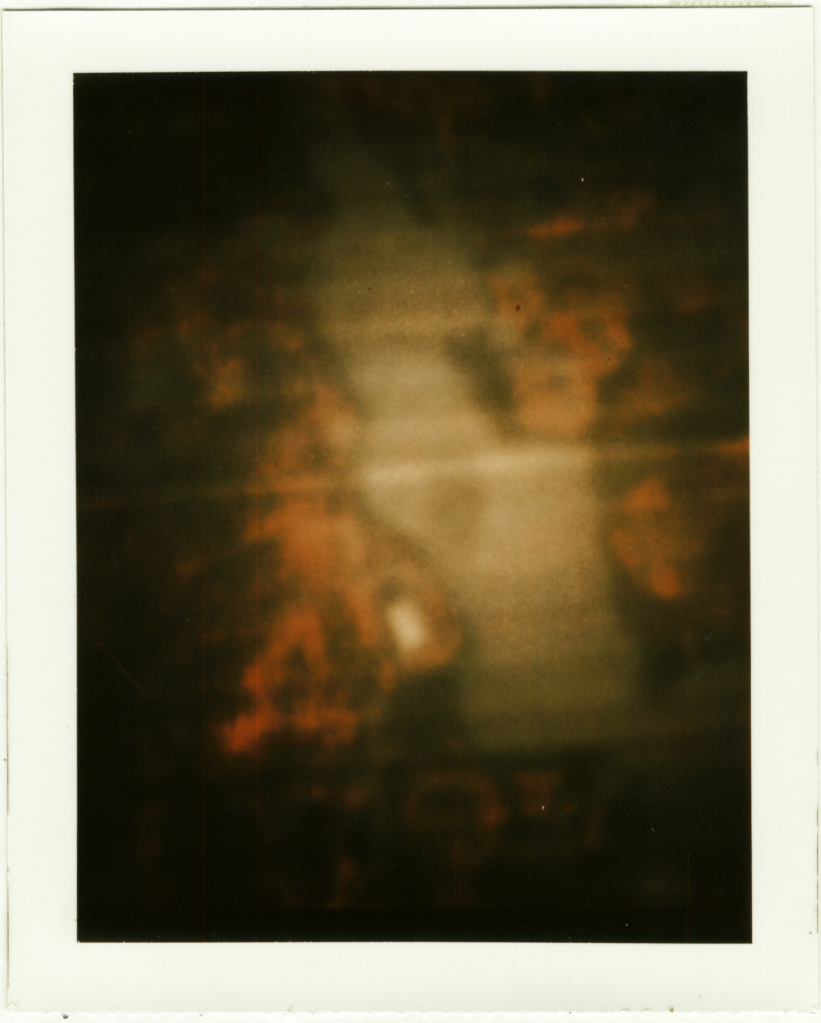

Figure 5. False-color rendition of the waste discharge area as projected through a multispectral viewer. MSS Band 4 is projected through clear, Band 5 is projected through a green filter and Band 6 is projected through a red filter. Scale is 1:62,500 or one inch to one mile. Reproduced on Type 58 Polacolor film.

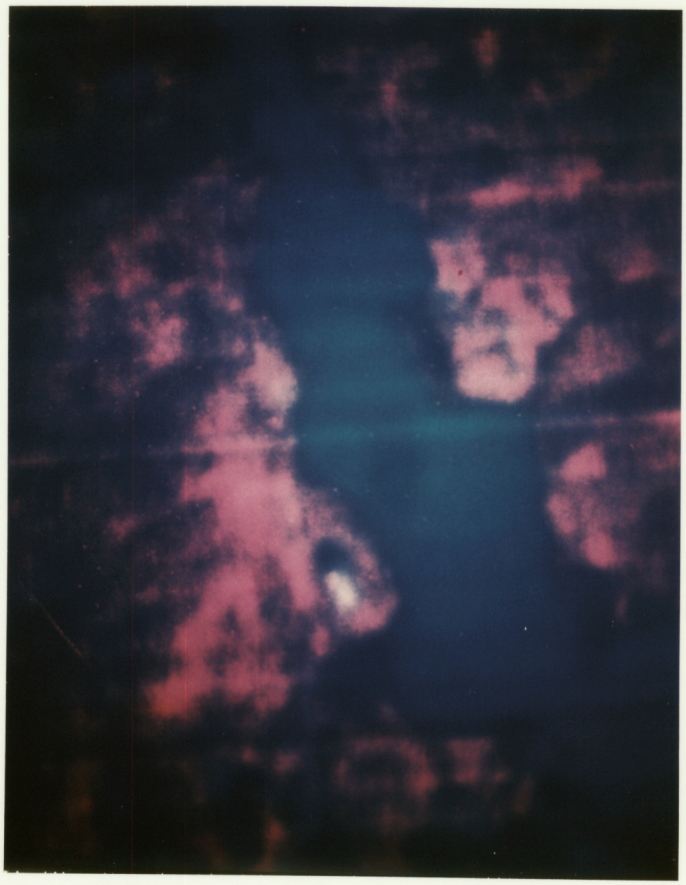

Figure 6. False color rendition of the waste water discharge area similar to the color infrared mode of aerial film. Band 4 is projected through a blue filter, Band 5 is projected through a green filter and Band 6 is projected through a red filter. Scale is 1:62,500 or one inch to one mile. Reproduced on Type 58 Polacolor film.

Summary of Significant Results

NASA Category 7.C. Lake Pollution Surveys

A major waste water discharge plume generated by a large paper mill along the New York shore of Lake Champlain was visually detected on ERTS-1 imagery. The plume is best displayed in 9.5 inch positive transparencies of MSS bands 4 and 5. Observation of the magnitude and extent of this plume is feasible, under magnification of 4 times. The chemical parameters of this plume have been documented by limnological studies.

NASA Category 8.E Image Enhancement Techniques

An enhancement technique useful for documenting the presence of waste water discharge plumes in Lake Champlain utilizes Polaroid MP-3 copy camera equipment and Spectral Data Corporation's Multispectral viewer. The 9.5 inch, ERTS-1, positive transparency is enlarged photographically through the use of Polaroid MP-3 copy camera to produce an enlarged lantern slide size positive transparency. These are projected through the multispectral viewer for enhancement and the scene is viewed directly on the screen or copied by an additional photographic step. The technique is simple and produces rapid results.